

# The Municipal Wildlife Habitat Conservation Strategy

**Caroline Astley**

*Wildlife Program Coordinator, Langley Environmental Partners Society*

## Abstract

The objective of the project is to protect and restore a healthy diversity of native wildlife species and habitats throughout the Township of Langley in perpetuity. The methodology implemented to achieve this goal includes: land cover identification through ortho-photo (aerial photo) interpretation and land cover polygon mapping; ground-truthing through visual assessments and land-owner contacts; the construction of a species/habitat database to determine critical habitat types and linked to a GIS; and working closely with municipal staff, Township Council, senior agencies and the community to establish a set of achievable habitat objectives to help conserve and restore habitat throughout the Township. As the project is still ongoing, there are only a few results to date, but these include: the establishment of an Invasive Species Program; co-operation with the Oregon Spotted Frog Recovery Team; a successful forum on habitat issues in a local community; and the completion of land-cover mapping and database construction. Broader implications for this project include the use of the program as a pilot project for other municipal initiatives, establishing connectivity between this project and provincial and federal programs, and as a way to monitor local species presence and land use on an on-going basis through community input.

## Introduction

### Background

The Municipal Wildlife Habitat Conservation Strategy is being developed through the Langley Environmental Partners Society (LEPS). Formed in January 1993, LEPS is a community-government partnership among several local, regional and senior government organizations, universities, First Nations, community stewardship groups and naturalist groups. Its goals and objectives are as follows: to promote and conduct watershed protection and restoration activities in



Langley; to provide technical support to community volunteer groups conducting environmental work; to provide education and work experience for students in areas related to environmental sciences; and to foster community cooperation in the Langley area through environment-oriented partnerships among government, teaching institutions, community associations and businesses. As well as being active within the local community, LEPS also works closely with the cities of Surrey and Abbotsford and also with the Greater Vancouver Regional District providing information and experience to different initiatives. Due to its position within the Township of Langley as a liaison between stewardship groups, the community and the municipal government, LEPS is ideally suited to work with the Township of Langley staff in order to incorporate wildlife values into planning and development plans. The Municipal Wildlife Habitat Conservation Strategy is linked to the Greater Vancouver Regional District's and BC Ministry of Water, Land and Air Protection's Biodiversity Strategy as a pilot project, sharing information, data and ideas freely, and providing a model for larger scale projects. Information is also being provided to Environment Canada, Canadian Wildlife Service for some of their projects and initiatives.

Some of LEPS' current activities include: an invasive species control program; coordination of several watershed societies including the Glen Valley Watershed Society and the Yorkson Creek Watershed Society; environmental education for local schools; public events including Salute to Salmon and BC River's Day; stewardship programs; youth programs; mapping and inventory of streams and creeks throughout the Township of Langley; riparian and salmon habitat restoration; exclusion fencing on agricultural land; tree and native plant plantings; and the Wildlife Habitat Conservation Strategy.

### The Problem

In the rapidly developing regions of the Lower Mainland, habitat fragmentation has become a reality. Species are being lost every day as available habitat shrinks to tiny, disconnected patches surrounded by houses, parking lots and big box retailers. Unfortunately, population growth is an eventuality, and as more and more people flock to the west coast for its idyllic views, temperate climate and rugged beauty, natural areas must give way to development.

Located approximately 50 km east of Vancouver, the Township of Langley is a region 303 km<sup>2</sup> in size that is experiencing this rapid growth in development. The population of Langley is expected to double in the next 20 to 25 years, from its present size of 88,000 to approximately 165,000 people (T. Lyster 2000.). The expanding development also threatens to further fragment an already patchy landscape. Neighbourhood plans are already underway to provide housing for several hundred new residents in several of Langley's communities. Development for housing and other needs affects wildlife and wildlife habitat both directly and indirectly (Theobald et al. 1997). Native vegetation is quite often removed to make way for housing, and the landscape of an area is generally altered during construction (Theobald et al. 1997).

The problem becomes how to allow development with population growth in mind, while maintaining wildlife habitat. Fragmentation has been proven to be detriment to wildlife species, placing an emphasis on generalist edge species and limiting biodiversity in a given area. Fragmentation can take many forms, with old field transformed into agricultural land, old-growth forests cleared completely and shrubs turned into housing developments (Collinge 1996). It can also reduce the effectiveness of predators, decrease seed dispersal and limit the viability of some bird populations (Collinge 1996). The end result of all of these processes is that available habitat shrinks and become further spaced apart, limiting movement of species from one patch to another.

Langley is home to more than 261 species and subspecies of mammals, birds, amphibians and reptiles. These include resident, migrant, vagrant and exotic species. Many of the subspecies found here only occur in the Lower Fraser Valley. There are also several Red- and Blue-listed (endangered or threatened) species found here, including the red-legged frog, the Western grebe and the peregrine falcon *anatum* subspecies. Many of the species in Langley have very specific habitat needs, and some, including the Western pond turtle and Southern red-backed vole *occidentalis* subspecies, may already be extirpated due to habitat loss.

Some solutions that have been suggested to curb the effects of fragmentation on wildlife include: the establishment of conservation covenants on private land; easements created by the local government; protection of large tracts of wildlife habitat through purchase by local governments; and the creation of corridors between patches. The approach that the Municipal Wildlife Habitat Conservation Strategy is focused on is conserving large patches of habitat and connecting them through a series of wildlife corridors, hedgerows and windbreaks. Easements and conservation covenants could also be used as an extension of this plan, and will be addressed once the strategy is in place.

The Wildlife Strategy aims to identify those areas of habitat that are most critical to species, identify historical connections between patches and attempt to reconnect them, educate community members on the importance of biodiversity and wildlife habitat in their neighbourhood, and is working with the local government to include wildlife values into development and planning proposals.

In order to preserve biodiversity, it is vital that remaining habitat be identified, ranked and marked for possible preservation or restoration, and inclusion into neighbourhood plans. In order to accomplish this task, the land cover of the Township is being mapped and analysed.

## Methodology

### Mapping

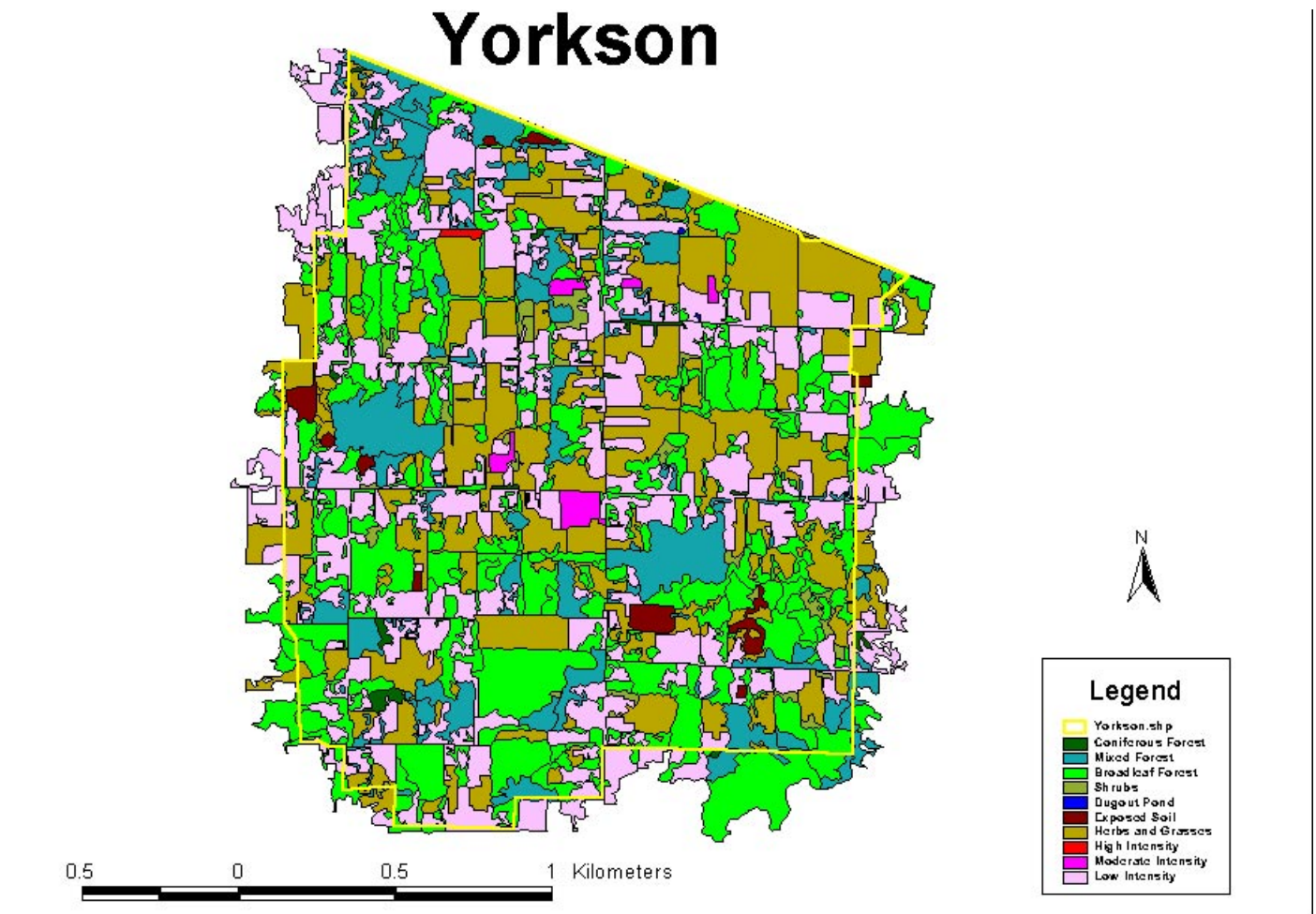
Using colour 1:20 000 scale 1995 aerial photos of the Township, land cover was identified using the following classifications: coniferous forest; deciduous forest; mixed forest; dugout pond; shrubs; herbs and grasses; wetland; exposed soil; high intensity development; medium intensity development; and low intensity development. Definitions of these classification types can be found at the end of this document in Appendix I, and are based on SHIM (Sensitive Habitat Inventory Mapping) techniques.

Each land cover type was then digitized in ArcView, a Geographic Information Systems (GIS) program at a scale of 1:5 000 with a minimum polygon size of 0.01 ha to give maximum detail. At the time of writing this paper, almost 90% of the Township has been mapped, with a polygon count close to 25 000. A confidence level of high, medium or low is also assigned to each polygon in order to aid ground-truthing efforts. Those polygons with medium to low confidence will be ground-truthed first to determine accuracy and composition.

The maps produced by digitizing land cover can be updated with the latest aerial photos, and by ground-truthing polygons on the ground. Ground-truthing involves describing habitat types in terms of composition of plant species,

diversity of plant species and structure of understory, canopy cover and correctness of interpretation, and incidental wildlife sightings. Potential and historical corridor connections can also be seen from the mapping. Queries can also be run to produce maps of specific neighbourhoods, proposed neighbourhood sites, proposed development sites and the area as a whole. Eventually, the maps will be linked to a species-habitat database which will allow interactive queries on species present and associated habitat types.

The following map of the Yorkson neighbourhood located in the northwest of the Township of Langley shows how the interpretation was accomplished and how the mapping and digitizing results may be displayed:



### Habitat Ranking

Once the mapping for an area is complete, habitat ranking can occur. There are several ranking systems for specific geographic regions available, but this one was adapted from Green Point Consulting, 1999:

Points	1	2	3	4	5
Size	< 1ha	1 – 5 ha	5 – 10 ha	10 – 20 ha	> 20 ha
Forest Diversity	Not diverse	Some diversity	Structurally diverse	Compositionally diverse	Structurally & compositionally diverse
Adjacency	To high intensity development	To moderate intensity development	To low intensity development	To agriculture/ shrubs/ fields	To wetland/ riparian
Interior	None (edge)	Some interior	Good Interior	Some deep interior	Deep interior
Connectivity	Patch	In proximity (< 2 km)	Somewhat connected (1 - 2 connections)	Well connected (> 2 connections)	Part of large forest > 20 ha
Riparian	No	Yes			

Using this system, excellent habitat would score 26 or 27 points (depending on adjacency) while poor habitat would score 6. This ranking system is somewhat subjective, but gives some indication of areas of importance. Ranking was also based on whether the site was a candidate for preservation and/or restoration. Sites of high diversity, interior and adjacency are ranked medium, high or top for preservation, while sites that are less suitable as habitat but have potential for wildlife are ranked medium, high or top priority for restoration.

Top sites for preservation are considered the best in habitat quality and of need of measures to protect them. High sites are of very good habitat quality and should be considered for protection, and medium sites are of good habitat quality and would benefit from protection.

Top sites for restoration are areas that may be connected to other sites of excellent habitat quality or may be improved through easy measures to enhance their overall quality. High sites are in need of some restoration, but may be expensive or of little value, medium sites may be areas of good habitat quality that are located close to a road or other unsuitable habitat and would benefit from buffers, corridors or other habitat enhancement, but may not retain good diversity or habitat.

Ranking the habitat patches identified during mapping will help to not only identify areas that would benefit from conservation covenants or purchase by the local government, but also those areas where public education would be beneficial.

### Focal Species

Of the 261 species found in Langley, a list of focal species was needed determine the habitat objectives. The species chosen as focal species were based on a set of features: were they a species of regional or national focus, were they appealing, were they a resident or migratory species, did they have specific habitat needs, were they representative of all habitats, were they an at-risk species, and how easy would they be to monitor.

An initial list was presented to the projects Steering Committee and a final list of 78 species under 16 habitat categories was completed. The habitat needs of these 78 species have become the basis for the habitat objectives that will be used by LEPS and the Township staff. The focal species list and habitat categories are included in Appendix II.

### Habitat Objectives

Currently, a set of habitat objectives based on species needs is being created. These objectives will be used by the local government to base their development and planning projects. They are in the form of non-spatial needs (broadleaf forest adjacent to farm fields), spatial, in hectares, based at a watershed level and designed to try to cover as much habitat as possible.

During the completion of the mapping, a species-habitat database was created in the database program Access 2000. This database contains information for all 261 species of mammals, birds, reptiles and amphibians occurring in Langley, and includes the 8 subspecies that are also found here. Much of the information was provided by the Northwest Habitat Institute and by the BC Ministry of Forests from their existing databases for BC, Oregon and Washington. Other information was added for specific Langley context, and some was changed for occurrence data. The database contains all life history, seasonal, spatial, diet and occurrence data for every species as completely as possible.

From the information gathered for the database, 78 focal species were chosen as the basis for the habitat objectives. These focal species were broken down into habitat classes (riparian shrubs, farm fields, mature deciduous etc.) and then used to determine minimum habitat requirement in terms of patch size, corridor usage, adjacency and special features. The habitat objectives will be brought before the local government staff from the planning, parks and engineering departments to come up with a compromise as to areas that must be preserved, areas that should be improved, and those that need to be reconnected. The goal of the objectives is to maximize the amount of habitat available while allowing development to occur.

Not only will the habitat objectives pinpoint those areas that require some form of protection, but will also identify areas that would benefit from restoration projects, either at a small or large scale.

### **Invasive Species**

Invasive exotic species are also a problem when habitat fragmentation occurs, and can cause damage to remaining habitat and species. LEPS currently has an Invasive Species Program up and running through the Wildlife Habitat Conservation Strategy. The goal of the program is to educate land owners, nurseries and gardeners about the dangers of using and selling exotic plant species. Education materials come in the form of pamphlets, education sessions and presentations to community groups. The program also deals with the problem of the American bullfrog which is currently threatening native frog species found in Langley.

## **Discussion**

### **Results to Date**

At the time of printing, the Municipal Wildlife Habitat Conservation Strategy is approximately halfway through the implementation phase of the project.

The following successes have been noted:

1. Wildlife values are being incorporated into small riparian restoration projects. This involves including down wood, perching poles and fallen logs into streamside restoration projects. Some of the down wood is to be modified by hollowing out logs to entice denning animals, cutting slashes into the underside of logs for salamander refugia and drilling holes into large dead trees to speed cavity excavation. At present, there is a "test site" being established along Yorkson Creek where some of these wildlife modifications can be tested and community education may be possible.
2. The first draft of the habitat objectives has been established. The habitat objectives will be the basis for the strategy created in collaboration with the Township of Langley parks, planning and engineering departments. So far, these objectives are spatial, non-spatial and comprised of mainly forested, riparian and grassland, corridor and wetland aspects of the landscape. The objectives include statements such as the following: "Streams should have 30 m naturally vegetated buffer on each side—absolute minimum are the 15 m setbacks allowed in some developments, but would push for 30 m minimum—improves drinking water quality as well as habitat", and are based on the Canadian Wildlife Service Ontario Region's *Framework for Guiding Habitat Rehabilitation*.
3. The first draft of the Willoughby Habitat Status Report has been created. This will be the basis for the Habitat Status Report due this year for the entire Township of Langley, and covers the amount and types of habitat present, where large patches are located, where corridors may be placed and which patches should be preserved or restored depending on their adjacency and diversity.
4. The species-habitat database is complete with only a few updates to be added and some small revisions needed. All information on life history, habitat requirements, seasonal movements and spatial movement are included, and this will also be the basis for interactive map queries. The database is based on information generously donated by the BC Ministry of Forests and the Northwest Habitat Institute.
5. Mapping of the township is 90% complete, with full completion expected by mid-May.
6. So far, the strategy has provided information to both the Oregon Spotted Frog Recovery Team and the Pacific

Water Shrew Recovery Team, and is still in contact with Strix Consulting, who are in the process of creating the Pacific Water Shrew Recovery Plan.

7. A highly successful public forum was held in the Willoughby area (located north of Langley city, on the western border of the Township of Langley) where interested community members were able to give input on the formation of the strategy. Their comments included: what they would like to see the strategy cover, identification of areas they felt were sensitive or of importance, and identifying areas of concern. These comments were then used in the creation of the Willoughby Habitat Status Report.

### **Remaining Tasks**

There are several tasks still remaining to be completed in the strategy. First, the Township of Langley Habitat Status Report is to be completed by the end of the year. Second, a volunteer monitoring program will be established for both habitat monitoring and species monitoring through training sessions, outreach materials and education. Third, the mapping component needs to be updated with the most recent aerial photos and ground-truthing information. Lastly, the strategy must be put into place and into writing through collaboration with Township of Langley staff to generate the methods required to attain acceptable results. The strategy must then be taken to the public for input, feedback and discussion.

### **Conclusion**

In conclusion, this program will go a long way in helping to conserve, protect and restore habitat for many of the species found in Langley, and it will hopefully act as a template for other municipalities hoping to establish similar projects. However, more research needs to be done on the occurrence of species in Langley, and ongoing monitoring will be important to gauge the success of any conservation efforts. Habitat also needs to be preserved and set aside as soon as possible, before neighbourhood plans are decided and while habitat values can still be included into plans. The Municipal Wildlife Habitat Conservation Strategy aims to provide a great example of what can be achieved when conservation values and development plans are used together to help preserve both wildlife habitat and to provide people with available and aesthetically pleasing housing.

### **Sponsors and Partners**

The Municipal Wildlife Conservation Strategy could not have been brought into existence without the generous support of all of our sponsors and partners. Our partners include the BC Ministry of Water, Land and Air Protection; the BC Ministry of Agriculture, Fisheries and Food; Environment Canada, Canadian Wildlife Service; the Central Valley Naturalists; The Langley Field Naturalists; The Greater Vancouver Regional District; the Township of Langley; Fisheries and Oceans Canada; and the Community Mapping Network.

For the period from March 2002 to March 2003 our sponsors included:

- Township of Langley
- EcoAction
- Habitat Conservation Trust Fund
- Wildlife Habitat/Habitat Faunique Canada
- The Real Estate Foundation of British Columbia

## Appendices

### Appendix I SHIM Land Cover Classification System

#### Land Cover Classes Used for Photointerpretation and Field Sampling

Class	Code	Description
Coniferous forest	VNF	Natural tree crown cover of 20 % or more of the total polygon area, and at least 80 % of the trees are conifers
Broadleaf forest	VBF	This area has a natural tree crown cover of 20 % or more of the total polygon area, and at least 65 % of the trees are broadleaf.
Mixed forest	VMF	Natural tree crown cover of 20 % or more of the total polygon area, of the total trees no more than 80 % conifer and no more than 65 % broadleaf.
Shrubs	VSH	The area has less than 10 % tree crown cover and natural shrubs constitute 20 % or more of the ground cover. Shrubs are defined as multi-stemmed woody perennial plants, both evergreen and deciduous. <b>Qualifier: d</b>
Herbs/grasses	VHB	The area has less than 20 % tree cover, less than 20 % shrub cover, and 20 % or more natural herbaceous cover. Herbs for this classification are defined as grass-like vascular plants, including ferns and forbs, without a woody stem. Some dwarf woody plants may be included in this category. A class qualifier must be assigned to this category. <b>Qualifiers: ag, n, ur, r, d, and u</b>
Exposed soil	NEL	Areas where recent disturbance, either human or natural, has exposed the soil substrate, such as in development sites or soil slides. The main characteristic is exposed soil under active erosion processes.
Human-made surfaces (high imperviousness)	NHR	Areas covered by highly impervious man-made surfaces such as pavement, concrete, and buildings with total impervious area > 40 %. This class can include industrial, commercial, and residential areas as well as roads and greenhouses. <b>Qualifiers: ag, ur, r, and d</b>
Human-made surfaces (medium imperviousness)	NMR	Areas covered by moderately impervious man-made surfaces with total impervious area between 10-40 %. This class is similar to the human made surface (high imperviousness) class but more vegetation is present. <b>Qualifiers: ag, ur, r, and d</b>
Human-made surfaces (low imperviousness)	NLR	Areas of low impervious human made surfaces with total impervious area < 10 %. Such areas may include low density suburban houses, barns, horse tracks, paddocks, or gravel or packed soil parking lots. <b>Qualifiers: ag, n, ur, r, and d</b>
Row Crops	NAG	Areas of agricultural crops and farmland. Agricultural areas where rows cannot be identified should be classified as Herbs/grasses with an agriculture qualifier.
Planted tree farm	NTF	Areas used as tree farms, including Christmas tree farms, ornamental tree nurseries, and fruit orchards.
Dug-out pond or reservoir	DOP	Dug-out ponds, either of natural or man made origin, which have been excavated and are maintained. They are mostly cleared of vegetation and may be under sudden human induced water fluctuations.
Natural wetland	WN	This class includes natural wetlands which are largely undisturbed by human modification and retain most of their natural characteristics.



**Class Qualifiers Used for Photointerpretation and Field Sampling**

Qualifier	Code	Description
Agriculture	ag	This area may be used for agricultural purposes including hay fields and grazing pastures.
Natural	n	This area is dominated by native herb/grass species and its appearance is not modified by human use.
Urban/ residential	ur	This area is composed of residential lawns, and may contain clumps of shrubs and trees. Vegetation is controlled and maintained by fertilizing, weeding, mowing, and pruning.
Recreation	r	This area is used for recreational fields, with heavily controlled and highly maintained vegetation. Examples of this area include golf courses, school fields, or parks.
Disturbed	d	This area has been recently disturbed and is undergoing early successional stages. Vegetation may consist of native and non-native grasses and/or small shrubs, and small patches of exposed soil may be visible.
Unknown	u	The use of this area cannot be identified.

**Class Qualifiers Used Only in Field Sampling**

Qualifier	Code	Description
Veteran trees	v	The area includes young or mature forest with scattered large old trees within.
Wildlife trees	w	This qualifier will be used in combination with forest classes when snags are present and have significant potential wildlife value.

**Vegetation Structural Stages Used Only in Field Sampling**

Class	Stage	Code	Description
Shrubs	Low shrubs	3a	Communities dominated by shrub vegetation less than 2 m tall; tree seedlings may be abundant; time since last disturbance is > 20 years for normal forest succession.
Shrubs	Tall shrubs	3b	Communities dominated by shrub vegetation more than 2 m tall; tree seedlings may be abundant; time since last disturbance is > 40 years for normal forest succession.
Forest cover	sapling	4	Typically there is a high density of trees: the main characteristics of this stage are: trees that have overtopped shrub and herb layers where self thinning is not evident. Trees are usually younger than 40 years for normal forest succession.
Forest cover	young	5	The main characteristics of this stage are that self-thinning has become evident and the forest canopy shows three distinct layers (overstory, intermediate, and suppressed). Dominant trees are generally between 40 and 80 years of age.
Forest cover	mature	6	The main characteristic of this stage is the canopy has begun to open and the understory has become well developed. Dominant trees are generally older than 80 years.
Forest cover	Old forest	7	The main characteristic of this stage is a structurally complex forest with snags and downed logs in all stages of decomposition and patchy regeneration. Dominant trees are generally older than 250 years.



**APPENDIX II**  
**Focal Species List**

**Open Water**

Painted Turtle  
Hooded Merganser  
American Coot  
Osprey  
Townsend's Big-eared Bat

**Wetlands**

Long-toed Salamander  
Green- and Blue-winged Teal  
Marsh Wren  
Rough-skinned Newt  
Common Yellowthroat  
Wood Duck

**Riparian Coniferous and Riparian Mixed Forest**

Pacific Slope Flycatcher  
Ensatina  
Western Screech Owl  
Band-tailed Pigeon

**Riparian Deciduous**

Great Blue Heron  
Willow Flycatcher  
Warbling Vireo  
Bullock's Oriole

**Riparian Shrubs**

River Otter  
Western Terrestrial Garter Snake  
Virginia Rail  
Yellow Warbler  
Wilson's Warbler  
Green Heron

**Unaffiliated or Special Measures**

Belted Kingfisher  
Killdeer  
American Dipper  
Common Snipe

**Mature Coniferous Forest**

Pileated Woodpecker  
Northern Flying Squirrel  
Brown Creeper or Red-breasted Nuthatch  
Douglas' Squirrel  
Olive-sided Flycatcher  
Winter Wren

**Young Coniferous, Deciduous, and Mixed Forest**

Townsend's Chipmunk  
Douglas' Squirrel  
Yellow Warbler  
Willow Flycatcher  
Pine Siskin  
Downy Woodpecker

**Shrubs**

Bushtit  
White-crowned Sparrow  
Common Nighthawk

**Hedgerows**

Bushtit  
American Goldfinch  
Western Meadowlark

**Grass – Improved Pasture, Unimproved Pasture, Old Field, Passive Recreation, and Active Recreation**

American Goldfinch  
Sandhill Crane  
Northern Harrier  
Red-tailed Hawk  
Barn Swallow  
Townsend's Vole  
Sora – further research in grass habitat  
Savannah Sparrow – needs large hay fields  
Barn Owl  
Short-eared Owl

**Farm Fields**

Common Snipe  
Trumpeter/Tundra Swans  
Northern Pintail  
Mourning Dove

**High Intensity/Moderate Intensity No Trees**

Peregrine Falcon  
Big Brown Bat/Little Brown Bat  
Brewer's Blackbird

**Moderate Intensity with Trees/Low Intensity**

Rufous Hummingbird  
Spotted Towhee/Dark-eyed Junco  
Violet-green Swallow  
Cedar Waxwing  
Pacific Chorus Frog  
Barn Swallow  
Bewick's Wren  
House Finch  
Song Sparrow  
Northern Flicker

**At-Risk Species:**

Oregon Spotted Frog  
Pacific Water Shrew  
Red-legged Frog  
Painted Turtle  
Western Grebe  
American Bittern  
Sandhill Crane  
Green Heron  
Gyr Falcon  
California Gull  
Short-eared Owl  
Band-tailed Pigeon  
Snowshoe Hare (esp. subspecies)  
Southern Red-backed Vole (esp. subspecies)

Long-tailed Weasel (esp. subspecies)  
Peregrine Falcon (esp. subspecies)  
Townsend's Mole  
Trowbridge's Shrew  
Townsend's Big-Eared Bat  
Keen's Long-eared Myotis  
Lewis' Woodpecker  
Western Meadowlark  
Great Blue Heron  
Trumpeter Swan  
Short-billed Dowitcher  
Western Screech Owl  
Barn Owl  
Hutton's Vireo

**References**

- Brophy, Laura. 1999. Riparian habitat prioritization: Tillamook Lowlands. **In:** A report to Philip Williams and Associates Ltd. Green Point Consulting. Corvallis, Oregon. 23pp.  
[http://yosemite.epa.gov/R10/ecocomm.nsf/6da048b9966d22518825662d00729a35/321bbc6939c3a7f388256cc5005d4e53/\\$FILE/gpc\\_pdf.pdf](http://yosemite.epa.gov/R10/ecocomm.nsf/6da048b9966d22518825662d00729a35/321bbc6939c3a7f388256cc5005d4e53/$FILE/gpc_pdf.pdf)
- Canadian Wildlife Service Ontario Region. 2000. Framework for Guiding Habitat Rehabilitation. Environment Canada.  
[http://www.on.ec.gc.ca/wildlife/factsheets/fs\\_habitat-e.html](http://www.on.ec.gc.ca/wildlife/factsheets/fs_habitat-e.html)
- Collinge, Sharon. 1996. Ecological consequences of habitat fragmentation: implications for landscape architecture and planning. *Landscape and Urban Planning* **36**:59-77
- Lyster, Terry. Director of Planning and Development, Township of Langley. 2000. Township of Langley. Conversation with Leanne Leith.
- Mason, B. and R. Knight. 2001. Sensitive Habitat Inventory and Mapping. Community Mapping Network, Vancouver, BC. 315pp + viii. M. Johannes, editor. [www.shim.bc.ca](http://www.shim.bc.ca)
- Theobald, David M., James R. Miller and N. Thompson Hobbs. 1997. Estimating the cumulative effects of development on wildlife habitat. *Landscape and Urban Planning* **39**:25-36